Module 3
Treatability Studies

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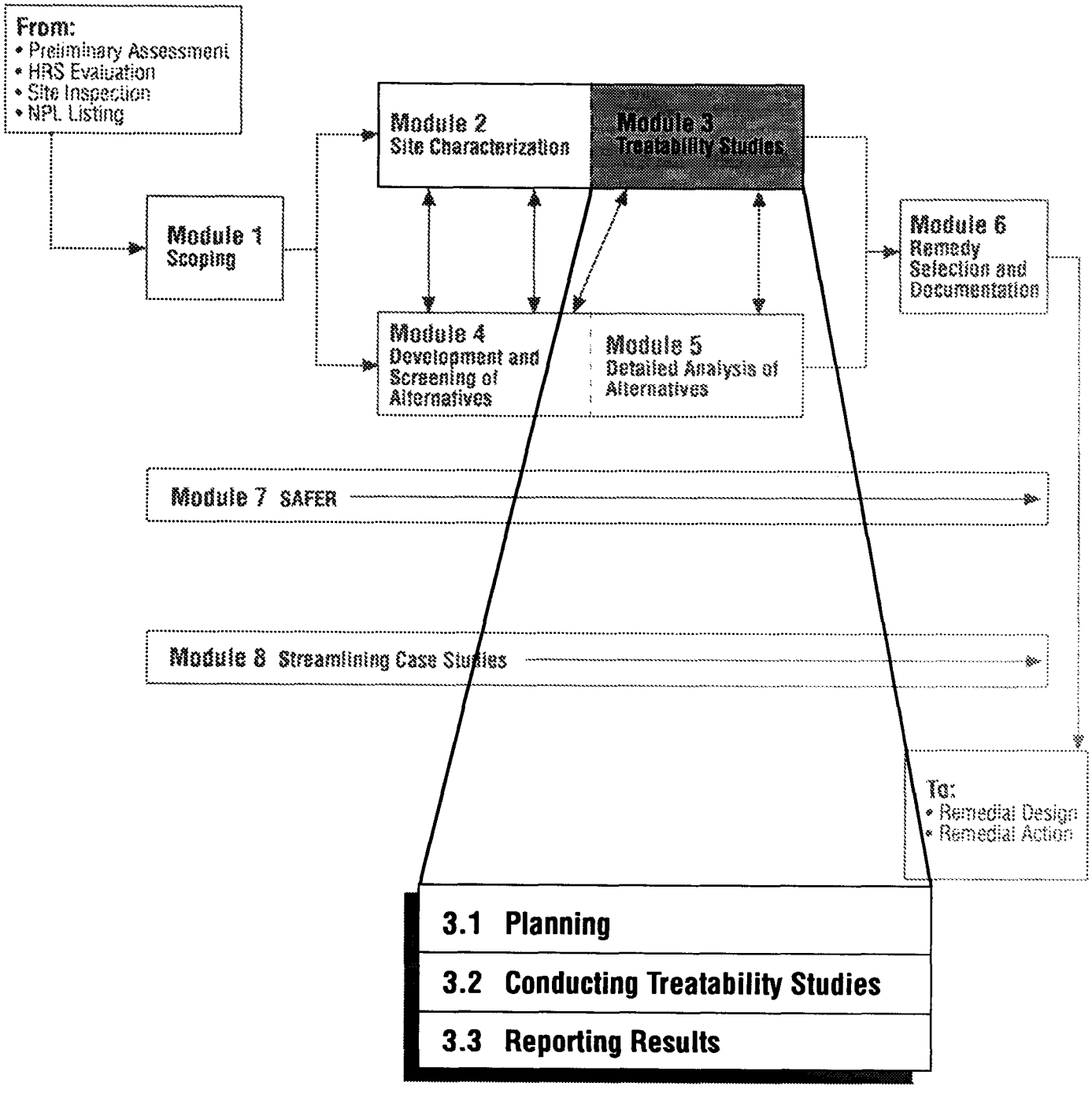
Module 3. Treatability Studies



Module 3
Treatability Studies

Background

Treatability studies are bench-scale or pilot-scale tests designed to obtain specific information that will aid in the selection and/or implementation of a treatment process. The principal value of treatability studies is that they can provide specific information that cannot be obtained from any other source. This is especially important for complex wastes and non-conventional treatment processes, when other sources of information cannot provide all of the answers to evaluate a treatment option. Typical output of treatability studies includes performance data, process reliability data, appropriate operating parameters, design criteria, Operations and Maintenance (O&M) requirements, and cost information.

Treatability studies reduce uncertainty. They can provide critical project-specific information, usually at a cost that is a small fraction of the total project cost. Reducing the level of uncertainty about a treatment process allows the treatment system to be designed less conservatively, resulting in lower capital and O&M costs. Savings accrued during design, construction, and operations can far outweigh the cost of a treatability study.

Identification of additional site or waste characteristics that should be clarified during the Remedial Investigation (RI) is possible because treatability studies are usually undertaken during the RI. Conversely, the treatability study results may indicate parameters that will not significantly affect applicability of the technology and that can be assessed during remediation through a monitoring plan.

The Environmental Protection Agency (EPA) has prepared specific guidance on treatability studies. This module provides additional guidance specific to Department of Energy (DOE) facilities. Because treatability studies involve treatment of wastes, produce waste residuals, and may be subject to permitting requirements, extended project team and stakeholder involvement is necessary in planning and implementation.

This module describes how to plan, conduct, and report the results of treatability studies. During planning, site managers prepare technical memoranda that become a treatability study plan. A detailed work plan, including conceptual design of the technology, is then prepared on the basis of the treatability study plan. A formal treatability study report is prepared at conclusion.

Organization

Module 3 is divided into three submodules

3.1 Planning
3.2 Conducting Treatability Studies
3.3 Reporting Results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Documents

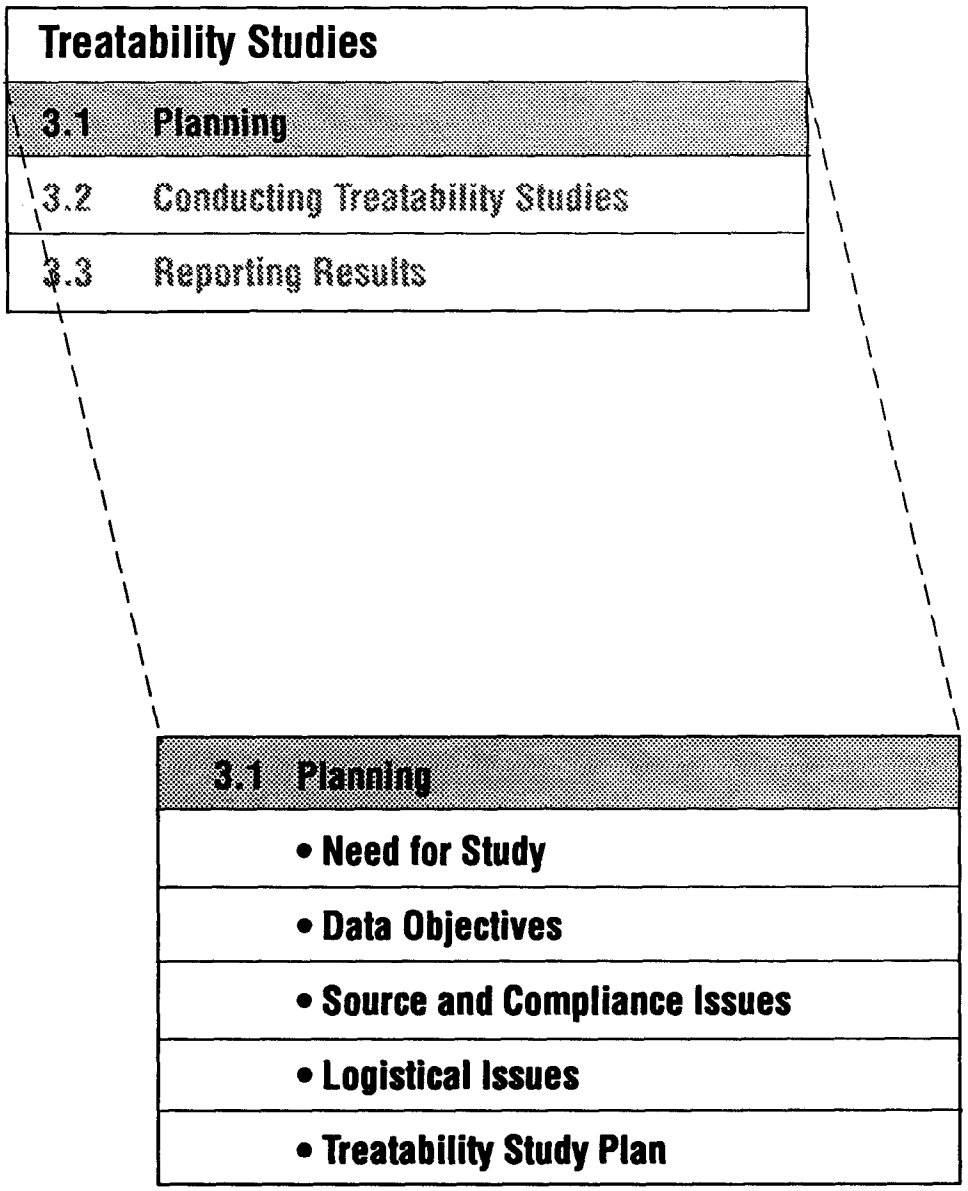
Informal and formal reports are used to document and communicate treatability study plans, activities, and results. The documents that should be developed for treatability studies include the following:

(1) Several technical memoranda that will comprise the treatability study plan

(2) Project work plan, that includes detailed design of the study and implementation direction

(3) Treatability study reports

Submodule 3.1 Planning



Submodule 3.1 Planning

Background

Because a treatability study (like a field investigation) is a data gathering effort, the data quality objectives (DQOs) process is critical to ensuring that only directly useful data (but all of the necessary data) result from the study. Many treatability studies, and even major investigations of remedial technologies, have been completed at great expense without generating the types of information needed by engineers to evaluate the technology, identify and estimate the costs associated with its use, or predict its effectiveness for a specific application. The DQO process is the best safeguard against such failures when designing and implementing treatability studies.

Field investigations deal with relatively small volumes (samples) of wastes; these wastes are exempt from certain waste management regulations. Treatability studies generally involve much larger volumes of wastes that may not be exempt from such regulations. Therefore, management of the wastes and residuals in a treatability study is more similar to these issues for a remediation than for a field investigation. Careful planning and attention to waste management issues are required throughout a treatability study.

Organization

Submodule 3.1 discusses the following:

- Need for study
- Data objectives
- Source and compliance issues
- Logistical issues
- Treatability study plan

In addition, more detailed information is provided in the following notes:

- Note A–Contrast Between Bench- and Pilot-Scale Treatability Studies
- Note B–Regulatory Issues During Treatability Studies

Sources

1. U.S. DOE, December 1991, *Guidance Manual for Conducting Technology Demonstration Activities*, Prepared by Oak Ridge National Laboratory, ORNL/TM-11848.

2. U.S. EPA, March 1987, *Data Quality Objectives for Remedial Response Activities,* Volumes 1 and 2, EPA/540/G-87/003A, OSWER Directive 9335.0-7B.

3. U.S. EPA, December 1988, *Assessment of Technologies for the Remediation of Radioactively Contaminated Superfund Sites*, Interim Final Draft, EPA/520/1-89-004.

4. U.S. EPA, November 1989, *The Remedial Investigation: Site Characterization and Treatability Studies*, OSWER Directive 9355.3-01FS.

5. U.S. EPA, December 1989, *Treatability Studies Under CERCLA: An Overview*, OSWER Directive 9380.3-02FS.

6. U.S. EPA, December 1990, *Guide for Conducting Treatability Studies Under CERCLA*, Interim Final, EPA/540/2-89/058, OSWER Directive 9380.3-02.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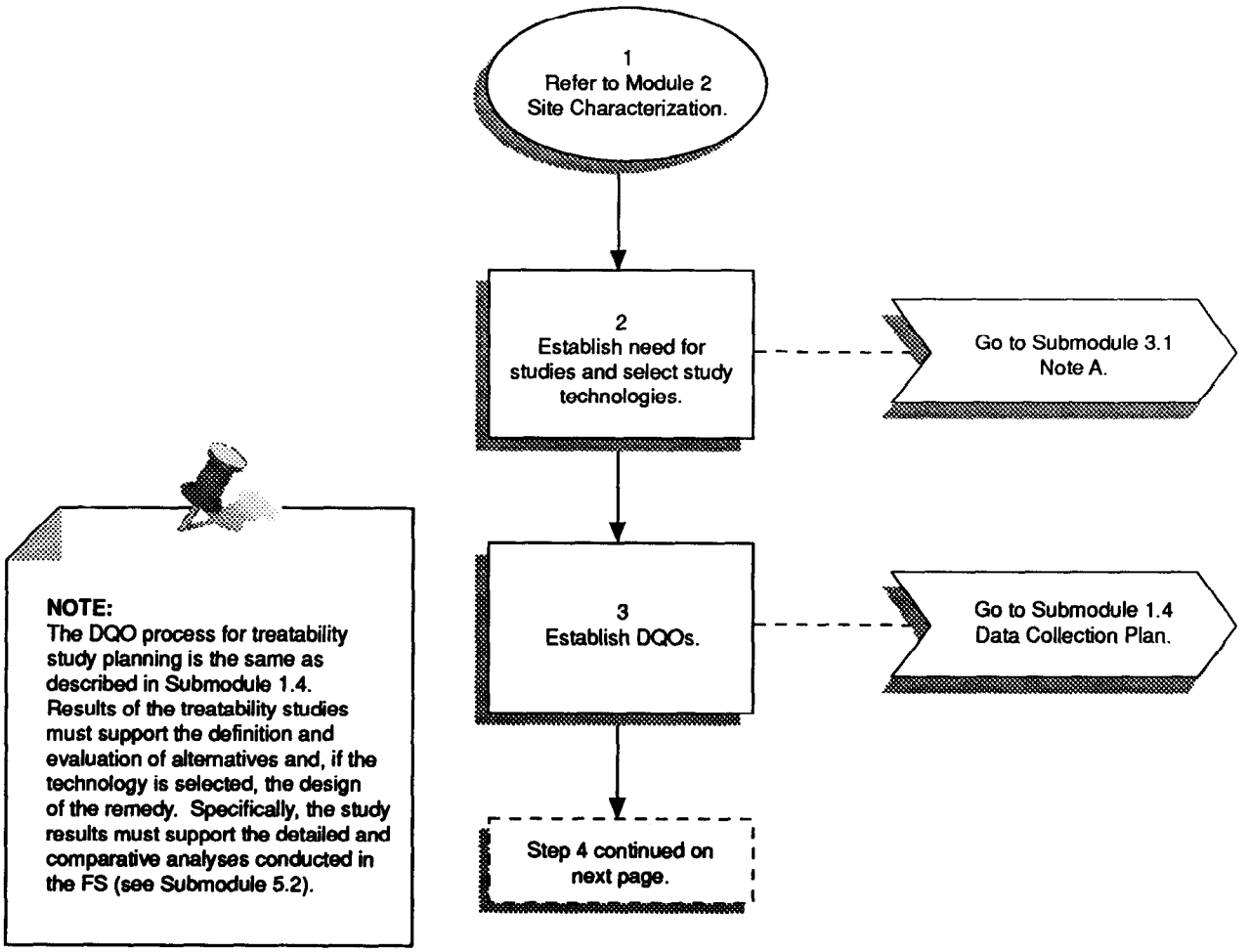
7. U.S. EPA, February 16, 1993, *Corrective Action Management Unit and Temporary Unit Rule*, 58 FR 8658.

Submodule 3.1 Planning



Step 1. Refer to Module 2, Site Characterization.

Step 2. **Establish need for studies and select study technologies.** The results of treatability studies may help to fill certain types of data needs that were identified in the work plan. Determining whether a particular technology will achieve necessary remediation goals often is not possible from data directly generated by previous uses of the technology. Evaluating the cost impacts of a technology may require onsite pilot-scale testing to establish key cost parameters (e.g., rate of treatment per hour, amount of contaminant extracted under local conditions). Treatability studies are expensive, require significant time to plan and implement, and sustain their own regulatory burdens. Less costly means of data collection may be more appropriate than a treatability study for filling a data need, even with greater uncertainty about the alternate data. Submodule 3.1, Note A, compares two standard types of treatability studies (pilot-scale and bench-scale).

Additional reasons for conducting treatability studies may exist at DOE sites. DOE sites often require innovative technologies because of their unique mixed waste problems. Therefore, treatability studies may be used to support the development of new technologies for mixed radioactive and hazardous wastes.

Selecting the proper technologies for treatability studies is another critical issue that must be considered early in the process. Scoping established consideration of possible remedial technologies and the need for treatability studies. Significant data about potential technologies is readily available from many EPA and DOE sources. The mission of DOE's Office of Technology Development (EM-50) is to support technology development and transfer. Many EM-50 programs (e.g., Integrated Demonstrations, Integrated Programs) can provide support that includes identifying potential technologies, screening technologies for use at a site, and assisting in physical transfer of the technology for onsite testing. EM-50 also can provide resources to conduct the study. Managers of operable units (OUs) should take full advantage of the information and the comprehensive range of services.

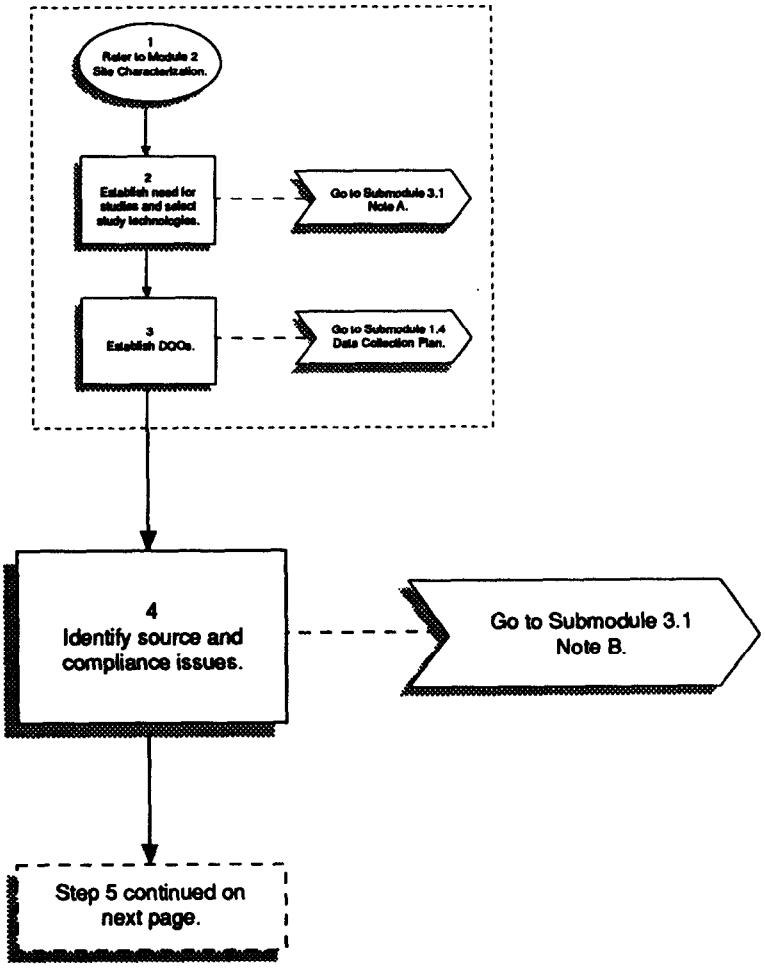
Step 3. **Establish DQOs**. The need for treatability studies and other likely studies was established at a conceptual level during scoping. As with all data collection activities, specific DQOs must be developed before the study can be designed. The DQO development process to be used here is the same as that described in Module 1.3. The initial DQO development process may have identified specific data needs that can only be met with results of a treatability study. DQOs that already exist for treatability studies should be reviewed and updated; additional DQOs should be developed that are specific to the technologies being tested.

DQO development requires extended project team involvement. Consensus should be achieved for the following issues:

- Data types that will be generated by the treatability study
- Quantity and quality needed for each data type, as well as for their uses in subsequent remedial decisions

The decisions made about these and other data issues generally will be documented in a technical memorandum that, along with other technical memoranda, becomes part of the

Submodule 3.1 Planning (cont.)



treatability study plan. Review of these results with stakeholders may be appropriate, particularly if controversial or innovative technologies will be considered.

For example, development of a DQO for a stabilization technology might include the following:

- Data gap. A stabilization technology is being considered for the surface soils at a site surficially contaminated with radioactivity. The soils would be excavated under controlled conditions, stabilized, and disposed of in an appropriate landfill. No information on the site soils is available other than the most general information in U.S. Soil Conservation Service soil surveys.

- Data use and need. Only basic physical and chemical information on the soils will be required for identifying viable stabilization technologies for the soils. These data will be gathered through the field sampling and analysis aspects of the RI. However, to develop and evaluate remedial alternatives that use stabilization technologies, treatability studies will be required for testing various stabilization reagents, additives, mixes, and curing times. Leaching tests will be required for determining performance in meeting the applicable or relevant and appropriate requirements (ARARs) specified by the regulatory agencies.

- Decision. Determine which stabilization technology(ies) will offer adequate performance against the seven evaluation criteria (see Submodule 5.2, Alternatives Analysis) and should be used in developing a stabilization alternative(s) for the Feasibility Study (FS).

Step 4. **Identify source and compliance issues**. Because of the significant number of issues that must be addressed before designing and conducting a treatability study, several scope and compliance issues must be resolved. These also will be documented in technical memoranda for review and approval by appropriate parties (i.e., extended project team) before starting actual study. These issues include the following:

Scope Statement. A scope statement is needed to define the study areas, technologies to be used, and estimated scale of the studies.

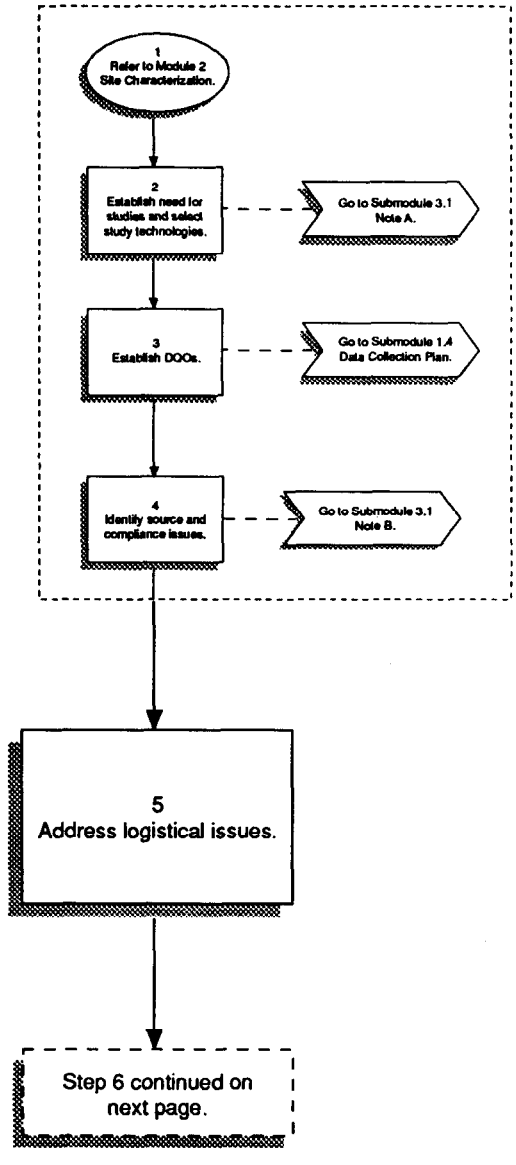
Funding. DOE Headquarters funds may be available to conduct treatability studies if EM-50 is involved in planning the activity. Routine operating funds may also be needed from field offices. Sources of funding, budgeting issues, and funds for any support contractors or vendors should be identified early.

Schedule. Potential scheduling issues include the following:

- Time of year to implement the study. Planning must ensure that the study can be done during representative seasons. If remedial action will occur over several seasons and could be affected by weather, conducting the treatability study in different weather conditions may be appropriate for determining its effectiveness.

- Timing of results. Site managers should ensure that the results of the study are available when needed in the RI/FS so that results can be used to support the site characterization or remedial response decision.

Submodule 3.1 Planning (cont.)



- Time to resolve setup problems. Include time in plans to allow for vendor selection, technology mobilization, and resolution of setup and initial operating problems.

- Time of study. Consider the length of time needed for technologies to produce the results (e.g., soil vapor extraction, where results are available immediately vs biological activities, where many weeks or months will be necessary to achieve results).

Regulatory Issues. Many regulations may affect the activities of the treatability study, including whether permits are required and how any wastes must be managed. Submodule 3.1, Note B, describes these regulatory issues in detail.

A technical memorandum must address how wastes and treatment residuals will be managed. All of the technical memoranda prepared during Step 4 become part of the treatability study plan.

Step 5. **Address logistical issues**. A logistical issues technical memorandum also will be developed to become part of the treatability study plan. Logistical issues, many of which are similar to mobilization prior to fieldwork, also exist with the planning and execution of treatability studies. These logistical issues include security, need for excavation and National Environmental Policy Act (NEPA) categorical exclusions, transportation, and operational readiness reviews. Other issues include the following:

Site access. In addition to access issues discussed in Submodule 2.1, an additional access issue is understanding how the treatability study might affect the results of other ongoing RI activities, and mitigating any undesirable impacts. For example, conducting a soil vapor extraction test could affect any further volatile organic compound (VOC) sampling results in that area.

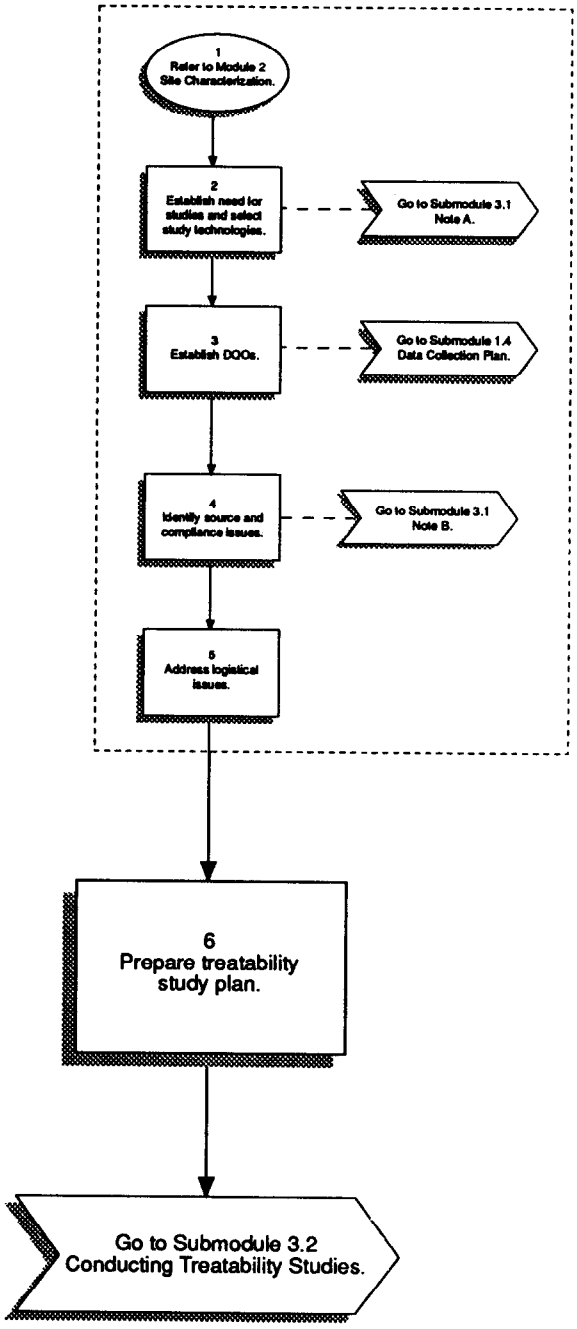
Safety analysis. DOE or site procedures may require that certain types of treatment processes meet safety analysis requirements prior to operation. Determine whether these requirements must be met, and allow for time to gather and present the needed information.

Procurement. Flexibility in procurement is required because treatability studies involve the testing of unknown conditions. Fixed-price contracts rarely are appropriate because extensive change orders often are required during implementation and because of possible deviations from expected site conditions.

Permits. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121(e) specifically exempts parties taking onsite CERCLA actions (e.g., DOE or its contractors) from obtaining permits for these actions. EPA has interpreted this provision to mean that parties must only meet the substantive aspect of regulations (e.g., performance standards) rather than administrative requirements (e.g., permits).

This permit exemption does not apply to Resource Conservation and Recovery Act (RCRA) corrective actions, where RCRA permits or permit modifications, or permits required under other laws may be required. Some permit exemption requirements may

Submodule 3.1 Planning (cont.)



exist under RCRA for corrective actions [e.g., for temporary units as defined in the new *Corrective Action Management Unit and Temporary Unit Rule* (EPA, 1993)].

Step 6. **Prepare treatability study plan**. All of the technical memoranda addressing scope and planning issues (e.g., data quality issues, scope and compliance issues, logistical issues) are now combined into a treatability study plan. This plan serves as the basis for preparing the work plan in Submodule 3.2.

Note A: Contrast Between Bench- and Pilot-Scale Studies

Treatability Studies	Example Testing Programs
A. Air Pollution and Gas Migration Control 1. Capping 2. Dust control 3. Vapor collection and treatment (carbon adsorption, air stripping, etc.)	Bench: Soil density and bearing capacity versus moisture content curves for proposed capping materials. Pilot: In-place soil densities; determination of gas withdrawal rates to control releases.
B. Surface Water Controls 1. Capping 2. Grading 3. Revegetation 4. Diversion and collection	Bench: Column testing of capping material compatibility with wastes present. Pilot: In-place testing of geotextiles for control of erosion in diversion ditches.
C. Leachate and Groundwater Controls 1. Containment barriers (slurry walls, grout curtains, etc.) 2. Groundwater pumping (well points, suction wells, etc.) 3. Subsurface collection drains 4. Permeable treatment beds (limestone, activated carbon) 5. Capping	Bench: Determination of basicity and headloss versus grain size of limestone materials for a treatment bed; determination of chemical compatibility of compacted clay with a leachate stream. Pilot: In-place testing of a soil-type and grain-size specification and tile-drain configuration for a subsurface collection drain.
D. Direct Waste Control 1. Thermal treatment 2. Solidification/stabilization 3. Biological treatment • Activated sludge • Facultative lagoons • Tracking filters 4. Chemical treatment • Oxidation/reduction • Precipitation • Neutralization • Ion exchange resins 5. Physical treatment • Carbon adsorption • Flocculation • Sedimentation • Membrane processes • Dissolved air flotation • Air stripping • Wet air oxidation 6. In situ treatment • Vapor extraction • Soil flushing • Microbial degradation • Neutralization/detoxification • Precipitation • Nitrification 7. Land disposal (landfill, land application)	Bench: Characterization of chemical and heat content of hazardous waste mixes; chemical, physical, and biological treatability studies to define rate constants, minimal-maximal loading rates and retention times, optimal pH and temperature, sludge generation rates and characteristics, and oxygen transfer characteristics; chemical type and dose rates; solids flux rate versus solids concentration in sludge thickening systems; air/ volume ratios for stripping towers. Pilot: Test burns to determine retention times, combustion-chamber and afterburner temperatures, destruction and removal efficiency, and fuel requirements for the incineration of a waste; endurance performance tests on membranes in reverse-osmosis units for groundwater treatment; in situ microbial-degradation testing of nutrient-dose and aeration rates to support in-place degradation of underground leak; evaluation of in-place mixing procedures for the solidification of a sludge in a lagoon.
E. Soil and Sediment Containment and Removal 1. Excavation 2. Dredging 3. Grading 4. Capping 5. Revegetation	Bench: Determination of soil-adsorptive (cation exchange capacity) properties and chemical composition. Pilot: Small-scale dredging to assess sediment resuspension or production rates.

Note A: Contrast Between Bench- and Pilot-Scale Studies

Note A. **Contrast Between Bench- and Pilot-Scale Studies.** Treatability studies are used for providing information to fill technology-driven data needs. RIs provide site information, both chemical and physical characteristics. Treatability studies provide information on the effectiveness and cost of a particular technology for a particular problem at a particular site. The accompanying table provides examples of bench- and pilot-scale testing for various technological data needs.

A treatability study is an investment made to reduce the unknowns or uncertainties in using a particular technology. Issues that can be resolved by treatability studies can be grouped into two categories as follows:

- **Basic feasibility of the technology−whether it will work for the problem**. Bench-scale tests can be used to answer the yes-no questions about technology use. They also can be used for identifying the major unknowns that will affect application of the technology to the particular waste or matrix. Bench-scale studies for resolving issues at this level can be useful prior to detailed alternatives evaluation in the FS, in order to remove uncertainties about whether the technology will work.

  Bench-scale studies also can be useful in deciding whether to use a mature technology. For mature technologies (e.g., incineration), bench-scale information is sometimes sufficient for deciding whether the technology will work for a particular waste as well as for defining with some confidence the scale-up factors that will determine costs, regulatory compliance, and other issues at full-scale remediation.

- **Quantifying parameters necessary to designing a Remedial Action (RA) with the technology**. Pilot-scale treatability studies can be used for quantifying the parameters that will determine technology cost and effectiveness. Pilot-scale treatability studies are primarily useful after completion of the FS and remedial decisions. They are much more expensive than bench-scale studies and typically are justified only when interest in a particular technology is high.

  The decision about whether a bench- or pilot-scale test is most appropriate depends on a number of issues including timing required for results, funding availability, and status of technology development and current use.

  Bench-scale studies use laboratory conditions to help determine applicability of technology elements (e.g., jar tests fort adsorption isotherms). Bench-scale studies tend to emphasize issues such as the type of contamination, concentration of contaminants, and the presence of interfering compounds, process kinetics, material compatibility, and reactant quantities. The incentive for bench-scale testing is the ability to investigate and gain significant information for relatively small cost and time investments. Bench-scale results typically are not useful for full-scale design issues, primarily because of scale difficulties in determining representative samples. For example, groundwater samples collected from monitoring wells during site characterization may represent conditions at that location, but may not represent sitewide conditions that the treatability study is focused on.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Pilot-scale tests generally are divided into two categories: partial and full scale. Partial-scale pilot studies are used to identify and quantify parameters that are critical in designing full-scale implementation. Technology scale-up often is not linear. In theory, treatability studies can be run under a variety of conditions to define the nonlinearity of scale-up. In practice, this is often much too expensive and falls more within the scope of a research issue. Engineering experience and judgment usually are relied upon in addressing this issue.

Full-scale pilot tests are performed in the field and are essentially limited, full-scale implementations of a remedial approach. Full-scale pilot studies are most appropriate when there is little or no experience with actual technology implementation (e.g., implementation of soil vapor extraction at a Superfund site in Michigan in 1987, when such technology had been previously used at only one or two sites worldwide). A pilot study involving 11 wells indicated that the system would be successful at a level exceeding all expectations.

Pilot-scale tests of technologies emulate, as closely as possible, actual site application. Pilot-scale tests help to determine the effectiveness and implementability of the technology. These tests are intended to bridge the gap between bench-scale analysis and full-scale operation. Pilot tests are expensive and require detailed planning similar to that for an RA. Because of the logistic complexities and cost, the need for pilot testing should balance the data need or savings in time or money that is realized during technology implementation with the additional time or cost required for pilot testing during the RI/FS.

A treatability study represents an investment in collecting additional information that will reduce the risk of failure or partial failure at RA. In deciding whether to make such an investment, it is necessary to consider the payback on the investment. Construction of an oversized or complex treatment plant or unit can be expensive, but the excess capacity may be less expensive than conducting a treatability study for optimizing the scale of the plant or process. Conversely, construction of a treatment process that fails to operate can be a complete loss of time and money.

Treatability studies cannot answer all questions or resolve all risks of failure during RA. Some scale-up concerns cannot be addressed through short-term studies, small-scale bench studies, or pilot studies. Leaks, fugitive emissions, odors, scaling, corrosion, poisoning of a catalyst, and degradation of liners are examples of the types of process parameters that generally are not quantified by a short-term treatability study. Considerable engineering expertise is required to account for such scenarios when scaling up a treatment process from a small-scale study.


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Note B.

Regulatory Issues During Treatability Studies. Different environmental laws and regulations could affect the conduct of treatability studies. The most significant laws potentially affecting a study are RCRA (or State equivalent hazardous waste regulations) and regulations governing any waste residuals (e.g., effluents, emissions) that might be generated during the study. In addition, DOE Orders may regulate any radioactive materials included in the study.

RCRA generally affects any actions that occur with hazardous wastes, including treatability studies. Examples of the types of requirements that may apply include hazardous waste identification, (e.g,, whether any of the residuals generated during the study are regulated as a hazardous waste); generator and storage requirements (e.g., if wastes are hazardous, requirements will need to be met for generators and storage facilities); and treatment requirements (e.g., whether unit-specific treatment standards apply).

In addition, RCRA contains specific requirements that exempt from regulation some wastes that are generated during treatability studies. Some states may have different requirements or different volume limitations. Wastes that are transported across state lines (i.e., sent to an offsite or out-of-state laboratory) are subject to the requirements of both states.

Air and Water Emissions. All emissions or effluents generated during a treatability study need to be evaluated to determine what, if any, regulations apply to their management. In many cases, determining requirements for air and water emissions will be two of the most significant types of analyses required, because these requirements are complex, require extensive discussions with regulators, and significant volumes of air or water emissions may be generated.

To resolve air and water emission issues, site managers should:

- Identify all waste streams or residuals produced by the study
- Identify all regulations that may affect the management of these wastes
- Develop a compliance plan (technical memorandum) to identify compliance options and preferred strategies
- Gain consensus on a preferred approach
- Ensure subsequent plans are developed to implement the approach, including changing planned treatability study activities if they are not in compliance

DOE Orders. If radioactive wastes are managed during a treatability study, DOE Orders will have to be evaluated. This includes Orders governing worker and public protection during the study, as well as Orders affecting waste management.

DOE Orders change rapidly and will require review at several points to ensure that all of the requirements are considered. In many cases, sites have developed their own procedures for complying with DOE Orders that often must also be met during


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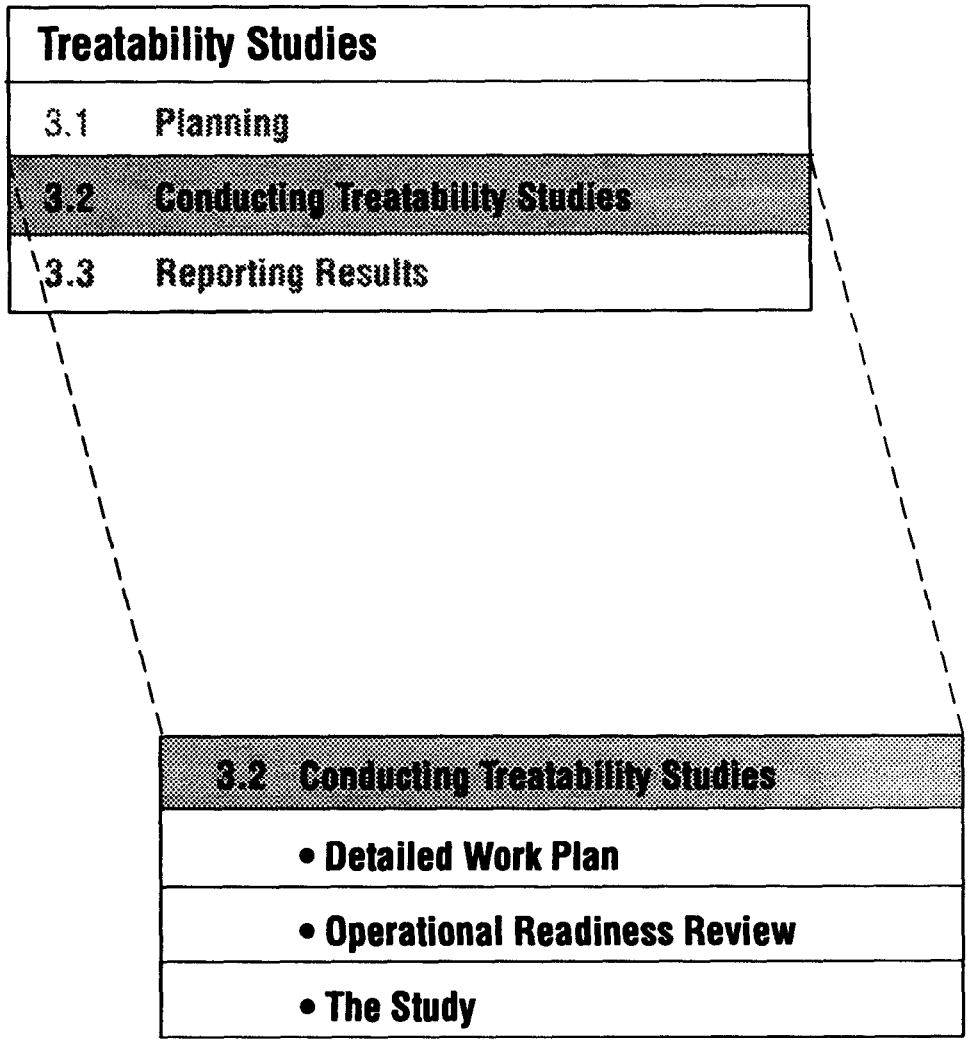
for environmental restoration, it may be necessary for DOE project managers or the designee to seek waivers or apply the Order using a "graded approach" to implementing the Orders.

ARARs Waivers. ARARs waivers may be appropriate if standards cannot be met during a treatability study. Waivers that may be most applicable are the interim measures waiver (because treatability studies are seldom considered final actions) or the technical impracticability waiver (if the technology is not capable of meeting specified treatment or operating standards). Technical impracticability may be particularly appropriate because treatability studies often are designed to test whether specified standards can be achieved.

Waivers should be considered during the planning of a treatability study, and documentation about their appropriateness should be included in the treatability study work plan. Note that the need for an ARARs waiver may not be realized until after the treatability study begins. In such a situation, additional documentation may need to be developed and submitted to regulators for approval after work plan approval. Submodule 6.2, Note B, provides additional information on ARARs waivers.

Submodule 3.2 Conducting Treatability Studies



Submodule 3.2 Conducting Treatability Studies

Background

Treatability studies are conducted through an external source–EM-50, a contractor, or a vendor of the technology being tested. A detailed work plan for the study is prepared by the external source and is subject to external project team consensus. An operational readiness review is conducted just prior to implementing the study, to ensure that all requirements will be met. During the study, the DOE project manager or designee needs to be apprised of certain management issues.

Organization

Submodule 3.2 discusses the following:

- Detailed work plan
- Operational readiness review
- The study

In addition, more detailed information is provided in the following note:

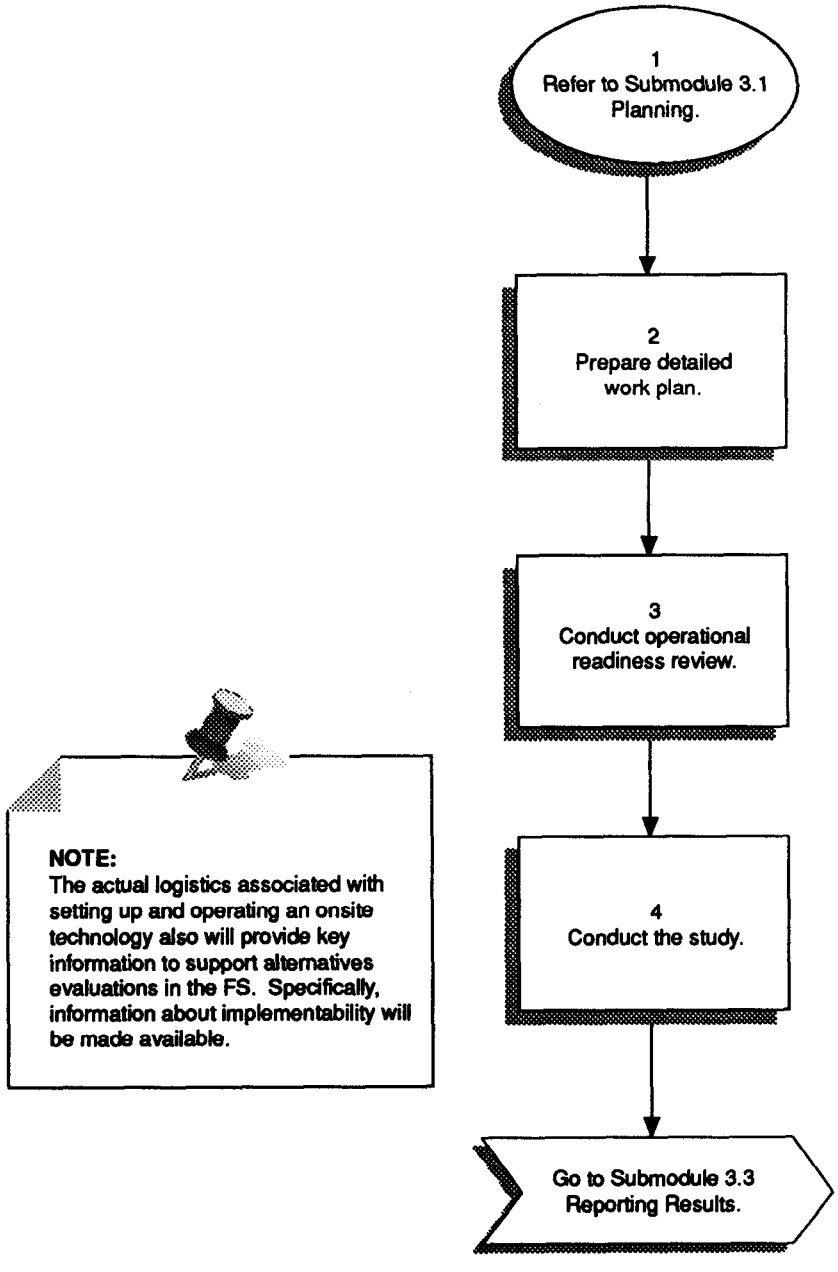
- Note A–Preparing Project Work Plan

Sources

1. U.S. DOE, December 1991, *Guidance Manual for Conducting Technology Demonstration Activities*, Prepared by Oak Ridge National Laboratory, ORNL/TM-11848.

2. U.S. EPA, December 1990, *Guide for Conducting Treatability Studies Under CERCLA*, Interim Final, EPA/540/2-89/058, OSWER Directive 9380.3-02.

Submodule 3.2 Conducting Treatability Studies



Step 1. Refer to Submodule 3.1, Planning.

Step 2. **Prepare detailed work plan**. Based on the treatability study plan prepared in Submodule 3.1, a detailed work plan will be prepared to include a conceptual design of the technology. The work plan will be designed to reflect all of the elements of the treatability study plan and will provide the details about how the plan will be implemented or achieved.

Detailed work plans for treatability studies may be prepared by different parties depending on how the study will be funded and managed. For example, a private vendor that brings a technology to the site may be responsible for preparing the work plan or site contractors or contractors that support DOE Headquarters may be involved in preparing or reviewing the treatability study report. Clear responsibility for work plan preparation and study review and oversight should be established early in the process.

Step 3. **Conduct operational readiness review**. Before initiation of the treatability study, all members of the internal project team should conduct an operational readiness review to ensure that all activities can be started according to the plan. For treatability studies, this review is generally an internal meeting that generates action items for resolution of any remaining issues.

Step 4. **Conduct the study**. Conducting a treatability study involves implementing the treatability study plan that was prepared in Submodule 3.1. Treatability studies seldomly progress as planned; changes in technology design and study approach are normal. Specific issues that could affect the conduct of treatability studies are as follows:

Early Results. Some studies require extensive time frames for obtaining final results. The study results, as available, should be evaluated and used for two purposes: (1) whether early results suggest the need for redesign and (2) whether the results can be used for other RI/FS purposes including Development and Screening of Alternatives (Module 4).

Scope Changes During Implementation. Changes to the scope of the study are often needed. Technologies either will not operate as planned or the results will vary greatly from what was expected (e.g., greater or fewer amounts of contaminants will be extracted or treated). With water treatability studies, unit operations (e.g., carbon filters) can be added or substituted if an initial approach does not work as well as needed. Each of these types of changes could require modification of the initial study design or implementation. Flexible procurement options and good planning enable easier changes for all parties.

Treatability Studies and Interim Actions. Some pilot-scale treatability studies may be implemented as interim actions or to satisfy regulatory or compliance agreement requirements. In these instances, points for terminating studies may be preestablished with the extended project team (e.g, after a certain time period, after certain amounts of contaminants are managed, after certain problems are addressed, or after certain amounts of residuals, such as effluents, are generated). These studies often are implemented much like remedial actions; expected conditions and reasonable deviations may be formally identified and contingency plans may be prepared so that the action can be continuously modified and implemented.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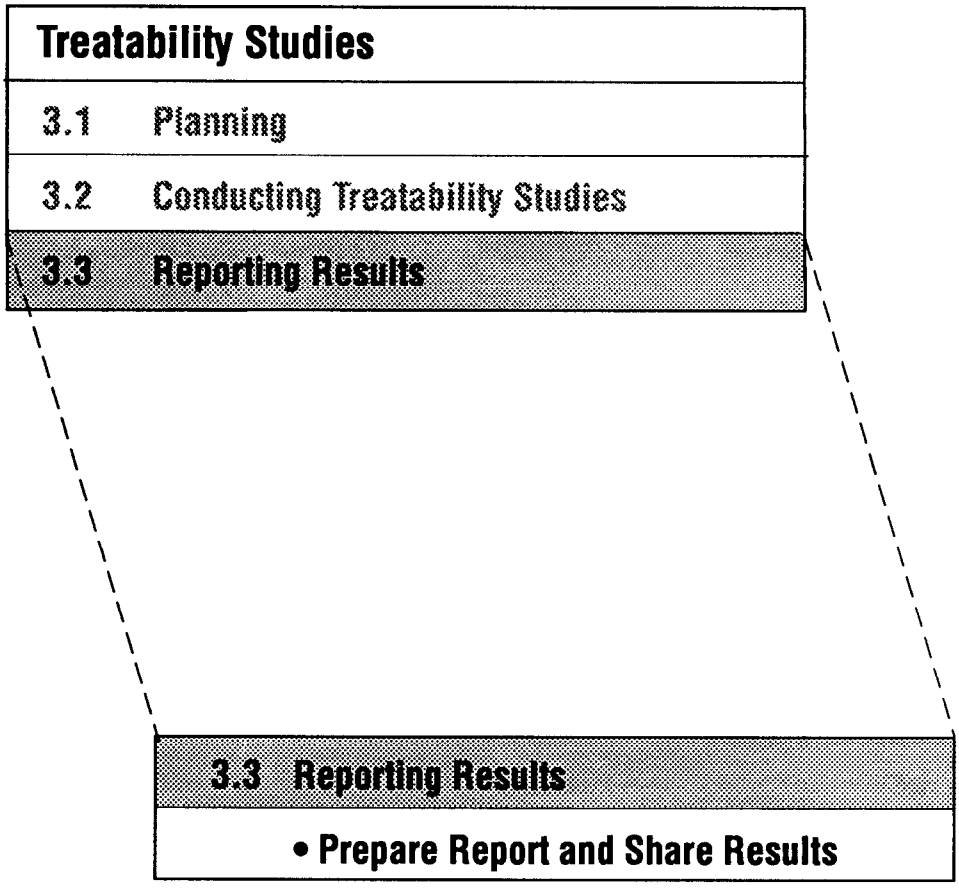
Other pilot-scale studies may be conducted more like research projects to fill data needs in the RI. These may not initially be conducted as removal or interim actions, but if necessary, may be converted to such actions to continue their operation. For example, a study that proves much more effective than planned may be continued or expanded. Such action requires gaining consensus of the extended project team, addressing regulatory issues (e.g., permitting), and documenting requirements [e.g., interim record of decision (ROD) with appropriate detail in the baseline risk assessment, ARARs analysis, and alternatives analysis]. Despite these requirements, converting pilot-scale treatability studies to interim actions may be a way to achieve valuable progress in addressing a site problem.

Submodule 3.3 Reporting Results



Submodule 3.3 Reporting Results

Background

The report for a treatability study should clearly delineate the objectives of the study, specify which objectives were met and any that were not met, and provide the detailed data and data validation results.

Organization

Submodule 3.3 discusses the following:

- Prepare report and share results

In addition, more detailed information is provided in the following note:

- Note A–Example Outline of Treatability Study Report

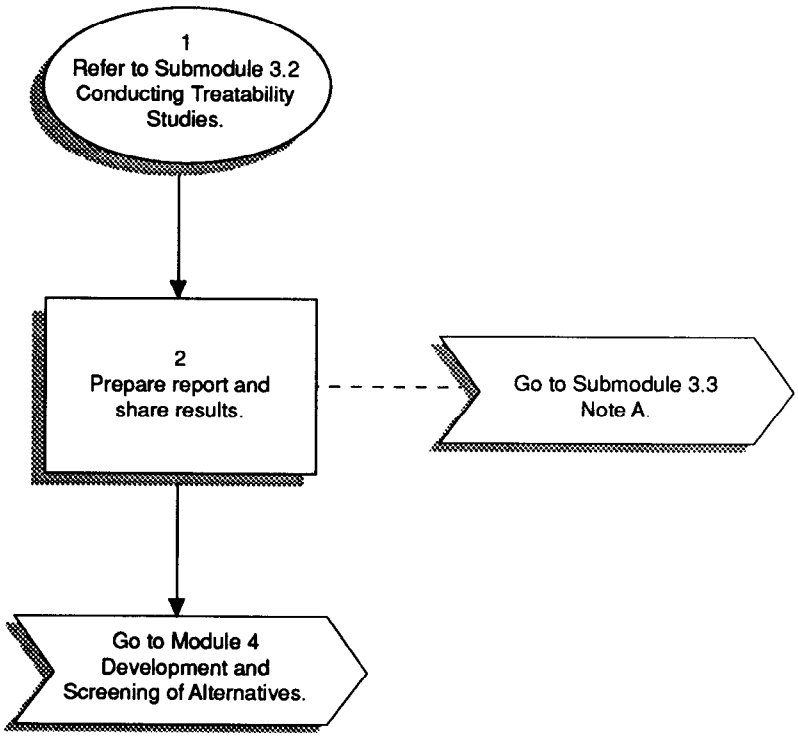
Sources

1. U.S. DOE, December 1991, *Guidance Manual for Conducting Technology Demonstration Activities*, Prepared by Oak Ridge National Laboratory, ORNL/TM-11848.

2. U.S. EPA, March 1987, *Data Quality Objectives for Remedial Response Activities,* Volumes 1 and 2, EPA/540/G-87/003A, OSWER Directive 9335.0-7B.

3. U.S. EPA, December 1990, *Guide for Conducting Treatability Studies Under CERCLA*, Interim Final, EPA/540/2-89/058, OSWER Directive 9380.3-02.

Submodule 3.3 Reporting Results



Step 1. Refer to Submodule 3.2, Conducting Treatability Studies.

Step 2. **Prepare report and share results.** After the treatability study is completed, a formal treatability study report is generally required. This treatability study report should be incorporated into the RI/FS report, shared with the extended project team and the stakeholders, and written to meet any requirements of organizations involved in funding or overseeing the study (e.g., EM-50).

The report should clearly identify the objectives of the study and the data collected; it also should evaluate whether the study met the objectives. An outline format for a treatability study is included in Submodule 3.3, Note A.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Note A. **Example Outline of Treatability Study Report.**

Executive Summary

1. Introduction
   - 1.1 Site description
     - 1.1.1 Site name and location
     - 1.1.2 History of operations
     - 1.1.3 Prior removal and remediation activities
   - 1.2 Waste stream description
     - 1.2.1 Waste matrices
     - 1.2.2 Pollutants/chemicals
   - 1.3 Remedial technology description
     - 1.3.1 Treatment process and scale
     - 1.3.2 Operating features
   - 1.4 Previous treatability studies at the site
2. Test Objectives
   - 2.1 Rationale
   - 2.2 Data Quality Objectives
3. Conclusions and Recommendations
   - 3.1 Conclusions
   - 3.2 Recommendations
4. Treatability Study Approach
   - 4.1 Test objectives and rationale
   - 4.2 Experimental design and procedures
   - 4.3 Equipment and materials
   - 4.4 Sampling and analysis
     - 4.4.1 Waste stream
     - 4.4.2 Treatment process
   - 4.5 Data management
   - 4.6 Deviations from the work plan
5. Results and Discussion
   - 5.1 Data analysis and interpretation
     - 5.1.1 Analysis of waste stream characteristics
     - 5.1.2 Analysis of treatability study data
     - 5.1.3 Comparison to test objectives
   - 5.2 Quality assurance/quality control

References

Appendices

- A. Data summaries
- B. Standard operating procedures


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